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# THE SIGNIFICANCE OF THE GREGARIOUS HABIT

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The gregarious habit occurs so frequently in nature as to indicate that it is an adaptation which must be of great biological significance. Considerable attention has indeed been given to this topic, but our knowledge concerning it is still far from complete, and even fragmentary contributions are not without their value. Certain studies of the habits of a gregarious bird which have been carried on by the writer during the past year (Miller, 1921) have suggested some ideas on the subject of the flock as an economic institution which may prove of more general interest than the limited scope of the investigation would seem to imply.

The Coast Bush-tit, *Psaltriparus mininius minimus* Townsend, is one of the most familiar passerine birds of the Pacific coast region, ranging through "Lower and Upper Sonoran zones of a comparatively narrow strip along the coast at least from the Oregon line south into northern Lower California" (Swarth, 1914, p. 510). It is a diminutive, drab bird, "top of head sooty brown; back dark grayish brown or brownish gray; under parts smoky brownish on sides. Length: 4.00–4.50 inches" (Bailey, 1917, p. 460). Peculiar, as the name suggests, to dense brush and chaparral, the Bush-tits forage about during the greater part of the year in loosely organized flock formation, which Grinnell (1903, p. 85) has admirably described as "a loitering company, scattered among several scrub-oaks or brush-clumps." These bands ordinarily consist of from fifteen to thirty individuals, but may occasionally number as high as sixty or seventy. Almost entirely insectivorous, they depend largely on scale insects and aphids for sustenance; various Lepidoptera and beetles, chiefly harmful, and some spiders, flies, and small wasps are also included in their diet (Beal, 1907, p. 74). Thus in their limited range, peculiar flock formation, and habits of feeding the birds occupy a place in the economy of nature which is unique.

The principal enemies of the Bush-tit are to be found among the smaller hawks, especially of the Sharp-shinned and Cooper species. The Sharp-shinned Hawk, *Accipiter velox,* does not soar and look for prey from above, after the manner of many hawks, but hunts actively through the tree tops where the smaller species of bird are likely to be found. Its method of striking is to dash through a tree, snatch a bird from its perch, and pass on without pausing. Thus its ecologic niche is such as to mark it as the Bush-tit's most formidable foe. Cooper's Hawk, *Accipiter cooperi,* is similarly a low flier, but, being a more powerful bird, it probably feeds upon Bush-tits only in the absence of larger prey.

The first and most obvious advantage of the gregarious habit is that it affords a multiplicity of eyes; the chances of sighting an enemy from afar are greatly increased; the alarm is sounded and measures for defense are taken. It is here that a further advantage of the flock over the individual becomes evident.

The reaction of a flock of Bush-tits to the approach of a Sharp-shinned Hawk or other avian enemy is extremely interesting. First, the most exposed birds sound the alarm and dash for cover. Those individuals feeding in the top-most branches are usually the first to perceive the danger; immediately they dart into the protection of the foliage, giving a shrill alarm note as they go. Then, as if by magic, the flock becomes stationary. Every bird is glued to its perch. Not a motion attracts attention to any particular individual. Simultaneously every throat gives utterance to a prolonged shrill, quavering note, the "confusion chorus" (Grinnell, 1903, p. 86), which, by its curious ventriloquial effect, renders the birds extremely hard to locate and distracts attention from any particular one. The flock remains thus motionless and the chorus is continuously uttered until the danger is past.

The effect of this upon a predaceous bird is obvious. Every sportsman knows that if he aims at a solitary water-fowl rising from the marsh, he is much more likely to bag his game than if he shoots recklessly into a flock. It is easier to hit a single bird than one of a dozen. The number of possibilities in the latter case distracts the attention from any one individual, and in consequence all are likely to escape. It may be stated as an axiom that the more the attention is divided, the greater is the possibility of failure. Now, in the case of the lower animals, the confusion arising from divided attention must be much greater than in ourselves. Animals appear to possess single track minds. They do not readily adapt themselves to puzzling circumstances. A dog may be taught to fetch a stick thrown by its master, but if two sticks are thrown at once, it is likely that neither will be brought. Division of attention means failure.

A hawk striking at a solitary Bush-tit would probably be successful in nearly every instance; but a hawk attacking a flock, every individual of which remains motionless, protectively colored and half concealed by foliage, no bird one whit more prominent than another, all uniting in a confusing cry, is likely to pass on without securing its intended prey. On half a dozen occasions I have seen a Sharp-shinned Hawk pass immediately over or through a flock of Bush-tits so reacting, without striking, although ordinarily it will kill in excess of its needs. It is extremely unlikely that mere caprice on the part of the hawk permitted the Bush-tits to escape. Rather it appeared that the predator was confused and unable to select a victim.

Of course, the hawk must sometimes be successful, or it would speedily grow tired of this game. Stragglers from the main flock are doubtless victimized most often. Theoretical computations based on the number of nestlings reared by a pair of Bush-tits each spring indicate a mortality rate of 250 percent of the minimum population. That is, for every 100 birds which survive from one breeding season to the next, 250 are killed, chiefly—as every ornithologist will agree—through the ravages of enemies, natural deaths being relatively rare among birds. But without a protective device such as the gregarious habit affords, the species would doubtless speedily become greatly reduced in numbers, or even exterminated.

Very interesting in this connection is an observation recorded by Allen (1920) on the behavior of sardines with reference to the attack of a loon. While the example is rather removed from the case we have been considering, the principle involved is identical. The loon made numerous dashes through a school of sardines, but came up each time without apparently capturing any of the fish; and Dr. Allen suggests "the possibility that the bird was unable to make a choice amongst so many chances before his opportunity was gone." It is to be noted that the striking feature of the behavior of the sardines was *uniformity*. Any departure from the stereotyped reaction would doubtless be fraught with immediate disaster. There is no room for originality. The individual is safe, not as an individual, but only as part of a group.

The advantage of concerted hostilities has long been recognized, but the evidence would seem to show that concerted pacifism or even concerted panic may be quite as effective as a measure of defense.

A further important advantage of the flock is to be found in its success as a foraging expedient. It represents the most economical method of range-occupation. Let us suppose, for purposes of illustration, that 100 birds of a given species occupy 100 acres of land as a forage ground. Three possible methods of procedure are open to them:

Every bird may roam at will over the entire territory, seeking what it may devour. Various individuals will cross each others' paths. One will forage unsuccessfully where another has been before him. All are likely to find scant fare. This method is unwise and wasteful; the greatest expenditure of time and energy is involved, with the least returns.

Another method, adopted by many birds, is that of apportioning off the territory by a sort of mutual agreement. Each bird will have a plot of its own, perchance an acre or so in extent, in which to forage intensively. Property rights are, of course, recognized very vaguely, if at all, but in a general way the individuals keep spaced out, so that there is little overlapping of forage grounds. This method, while a great improvement on the foregoing, is not ideal. Variations in the nature of the different portions of the territory thus occupied would be likely to give to certain birds an advantage over the others in matters of food supply and protection from enemies. Birds which chanced to occupy poorer portions of the range would fare badly.

Both of the above methods involve competition. Under certain circumstances competition may be very desirable, but here it is wasteful and dangerous. The general struggle for existence is sufficiently keen to keep the species up to its highest level of development. Competition within the species is unnecessary and extravagant, and it puts a species which practises it at a distinct disadvantage. The species which substitutes cooperation for competition promises to be the most successful.

The flock organization of the Bush-tits represents the third possibility of range occupation. It insures that each individual shall share in the benefits of the entire forage range, yet without any wasteful crossing of each other's paths, as would be the case if each hunted alone. Time and energy are conserved. Moreover, multiplicity of eyes is here once more of advantage, meaning greater probability of finding food. Pycraft (1910, p. 136) observes of the Long-tailed Tit, an Old World species of similar habits:

"The vagrant bands . . . are held together very largely at any rate by their common needs. The discovery of insect food at this time is an arduous task, and if undertaken individually, many would starve. As Professor Newton remarks: 'A single titmouse searching alone might search for a whole day without meeting with a sufficiency, while if a dozen are united by the same motive, it is hardly possible for the place in which the food is lodged to escape their detection, . . . and a few call notes from the lucky finder are enough to assemble the whole company to share the feast.'"

This is the true socialism, nature's ideal political economy. The Bush-tits have all things in common, yet each is dependent on its own efforts for a livelihood. There are no overseers, yet there are no shirkers; necessity sees to that. No humanly devised Utopia has ever approached this in practicability. Each individual in striving for its own welfare unconsciously labors for the good of all. The success of the plan is due to the fact that it is entirely automatic and unvolitional, and not dependent upon any capricious altruism; consequently the element of selfishness does not invalidate it. If the food call is given, it is primarily because an individual has found food; only secondarily does this serve as a signal to its fellows. If the alarm note is uttered, it is primarily because some bird is alarmed; probably unintentionally this acts as a warning to its companions. Yet the summation of these individual acts, pure reflexes in many cases, is a mechanism by which the safety and well-being of the entire flock is promoted.

That the plan is successful in the case of the Bush-tits an observer may convince himself in a few hours' time. They are a dominant species. In the region about Berkeley they compose a strikingly large proportion of the avian population, and are certainly twice as numerous as any other species. In 27 published accounts of their occurrence elsewhere in California which have come to my notice, they are twelve times characterized as common or abundant. It thus appears evident that the Bush-tit is in this region our most common—hence most *successful*—bird, and doubtless so largely for the reasons that have been suggested.

## SUMMARY

Observation of the habits of a gregarious species of bird has indicated that the flock is an adaptation possessing definite survival value:

1. The flock affords the advantage of a multiplicity of eyes, thus increasing the chances of sighting an enemy from afar.
2. The flock, by a uniform type of behavior on the part of its component individuals upon the approach of an enemy, tends to confuse the enemy by dividing its attention among a number of possibilities.
3. The flock represents the most economical method by which a given number of individuals can occupy a given forage range.
4. The Coast Bush-tit, a bird in which the gregarious instinct is highly developed, is demonstrably one of the most successful species in its range.

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